ScienceNews for Students

PHYSICS

Why the knuckleball takes such a knucklehead path

The new explanation traces to a 'drag crisis'

BY EMILY CONOVER JUL 21, 2016 — 7:00 AM EST

A knuckleball is due to how the pitcher grips (seen here) and releases a baseball. Physicists have a new explanation for the seemingly unpredictable trajectory of this pitch.   Knuckleballs baffle baseball hitters. These balls seem to swerve along their path unpredictably. A new study suggests a possible cause of the pitch's erratic flight. It suggests that the ball experiences sudden changes in air resistance, or force of drag. The scientists describe this as a "drag crisis."

Scientists described their finding July 13 in the New Journal of Physics. Their result is at odds with previous research. It had concluded that the zigzags in the ball's flight path were due to the effect of airflow over the baseball's seams. Knuckleballs occur when balls sail through the air with very little spin. This produces unstable flight. Although best known in baseball, similar effects also confound players in soccer and volleyball. In drag crisis, the flow of a thin layer of air that surrounds the ball flips between turbulent and smooth. This abruptly changes the drag on the ball. If the transition occurs in an asymmetric pattern, it can push the ball to one side. "This phenomenon is intermittent" and hard to predict, says Caroline Cohen. An author of the new study, she's a physicist at École Polytechnique in Palaiseau, France. "We can't know in advance [to] which side it will go, Cohen says of the balls. Those balls must move at a particular speed to experience a drag crisis. And that may be why knuckleballs tend to be slower than other pitches, her team notes. While the fastest pitches can top 100 miles per hour (160 kilometers per hour), knuckleballs usually are closer to 60 or 70 miles per hour. For their new study, the scientists built a knuckleball machine. It launched a beach ball without any spin. They measured how much the ball veered off course. Then they calculated the ball's expected motion based on the physics of the drag crisis. Those predictions matched what the ball had done during their tests.

The scientists' calculations also correctly predicted knuckleball-like effects in soccer, volleyball, cricket and baseball. The same was not seen in sports like tennis or basketball. And that's due to the different properties of their balls, including textures, typical speeds and how far they fly. Alan Nathan studies the physics of baseball at the University of Illinois at Urbana-Champaign. He describes the new study as "a fine piece of work." But he is not entirely convinced by the new explanation for knuckleballs. "Wind tunnel experiments seem to strongly suggest that [their flight path is] associated

with the seams on the ball," Nathan says. Those seams can create turbulence that causes the ball to swerve. So knuckleballs may remain as much of a challenge to explain as to hit them.

Power Words

Drag The slowing force exerted by air or other fluid surrounding a moving object.

Erratic An adjective that describes something that happens at unpredictable intervals or a behavior that is unpredictable.

Resistance (as in drug resistance) The reduction in the effectiveness of a drug to cure a disease, usually a microbial infection.

Trajectory The path traced by a flying object.

Turbulence The chaotic, swirling flow of air. Airplanes that run into turbulence high above ground can give passengers a bumpy ride.